

Remarks/Arguments

Claims 12-24 are now active in this application. New claims 21-24 have been added. New claims 21 and 22 set forth oxidation and reduction process steps as requested by the Examiner, with the difference being the order in which the steps are conducted. This amendment is supported by the claims and specification as originally filed. New claims 23-24 correspond to original claims 19-20, but have different pendencies. The remaining amendments are to correct pendency of the remaining claims. No new matter has been added by these amendments.

Applicants' representative would like to thank Examiner Wong for the courteous and helpful discussion of the issues in the present application on October 20, 2003. Applicants would like to thank Examiner Wong for the indication that the claims, as now presented, would be allowable over the art of record. The above amendments and following remarks summarize and further expand on the content of the October 20 discussion.

The present invention relates to a method for the electrolytic transformation of at least one organic compound in an electrolysis cell. The method comprises the steps of oxidizing and reducing, in either order. A distinguishing point of the present invention is that these two electrochemical steps are performed at the same electrode of the electrolysis cell, and with the electrode having the same polarity in each step. This is significantly different from conventional processes using cyclic voltammetry, which does perform both oxidation and reduction steps at the same physical electrode of the system, but causes a switch in the electrode polarity (e.g. from anode to cathode and back) in order to perform the reaction. This is not the case in the present invention, which maintains the same polarity at the electrode, while performing both oxidation and reduction steps at that electrode.

Using a furan compound as an example, the present process causes oxidation of the compound at the anode and reaction with methanol, for example to give

dimethoxydihydrofuran. The two protons generated are then reduced to molecular hydrogen at the cathode. In prior art processes, the hydrogenation step to follow would be performed at the cathode, for example by having hydrogenation catalyst be a part of the cathode itself. However, in a preferred embodiment of the present invention, the hydrogenation catalyst is adsorbed on the surface of the anode, which causes the hydrogenation to occur at the anode site, using the hydrogen that was generated at the cathode.

Various of the claims stand rejected as anticipated or obvious over any of Chernyshev, Cleghorn or Oberrauch. However, as discussed during the October 20 interview, none of these references disclose a process wherein the oxidation and reduction steps occur, in either order, at the same electrode having the same polarity. Chernyshev discloses a process wherein cyclopentadiene is electrochemically reduced and then reacts with Fe^{2+} to form ferrocene. However, in each of the various experiments examined by the researchers, the outcome was the same: cathodic reduction of the cyclopentadiene to give cyclopentadienyl anion, which then reacts at the anode with the Fe^{2+} generated at the anode (see page 213, second to last paragraph; page 215, first full paragraph). This is not, however, the present invention, which requires that both reduction and oxidation occur at the same electrode having the same polarity.

Cleghorn discloses reduction of nitrobenzene to aniline, and is a study of the hydrogenation of organic compounds at palladium on nickel cathodes. However, this reference also does not disclose both reduction and oxidation occurring at the same electrode having the same polarity. In fact, a careful review of Cleghorn shows that the process being used in the Cleghorn investigation is based upon the use of cyclic voltammetry, which is not the present invention, as noted above. As noted at page 2689, left column at (i), the process being described is merely a hydrogenation (reduction) process which occurs at a single electrode, and does not involve an oxidation reaction on the same organic compound.

Oberrauch discloses the state of the art process in which oxidation occurs at the anode, followed by reduction at the cathode. This is clear from the examples, claim 1 and column 4, lines 3-12, in which it becomes clear that the hydrogenation catalyst being used by Oberrauch is applied to the cathode itself, thus requiring that any hydrogenation (reduction) reaction must occur at the cathode.

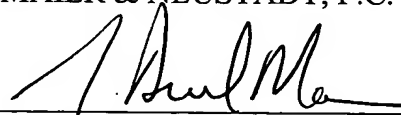
Accordingly, since there is no teaching in any of the references that the oxidation and reduction steps can occur at the same electrode of same polarity, and there is no teaching in any of the references of how one could accomplish such a process, the rejections should be withdrawn.

Claims 10-20 stand rejected under 35 U.S.C. 112, second paragraph. Applicants note that the Examiner is correct that in Claim 15, the graphite felt is the anode. Further, the rejection of claim 10 for lacking process steps is believed to be overcome by the replacement of claim 10 with new claims 21-22, which recite positive process steps as discussed with the Examiner.

Consequently, in light of the above discussion and in view of the present amendment, the present application is believed to be in condition for allowance and an early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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